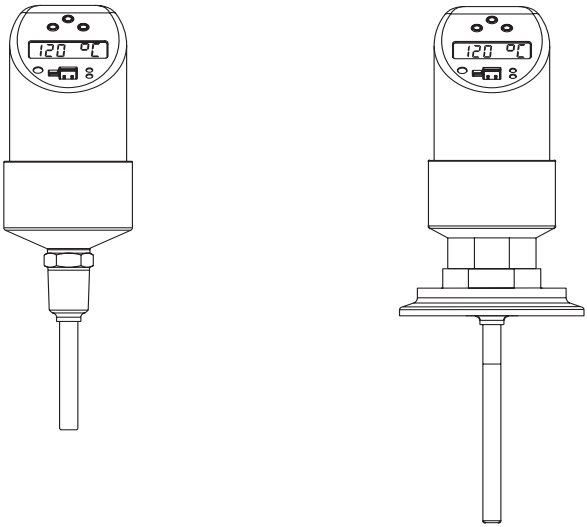
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating manual

Thermophant® T TTR31, TTR35

Temperature switch



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Release 01.02

Endress+Hauser

People for Process Automation

Brief overview

Using the following short form instructions you can commission your system easily and swiftly:

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1 Safety instructions

1. 1 Designated use

The Thermophant® T is a temperature switch for monitoring, displaying and regulating process temperatures. The device has been safely built with state-of-the-art technology and meets the applicable requirements and EC Directives. It can, however, be a source of danger if used incorrectly or for anything other than the designated use.

1. 2 Installation, commissioning and operation

Installation, electrical connection, commissioning, operation and maintenance of the measuring system must be carried out by trained, qualified specialists authorised to perform such work by the facility's owner-operator. The specialist must have read and understood these Operating Instructions and must follow the instructions they contain. The device may only be modified and repair work carried out if this is explicitly permitted in the Operating Instructions. Damaged devices which could be a source of danger may not be commissioned and must be labelled and identified as defective.

1. 3 Operational safety

The measuring device meets the general safety requirements according to EN 61010-1 and the EMC requirements according to IEC/EN 61326 in addition to the NAMUR recommendations NE 21, NE 43 and NE 53.

- Functional safety
  The Thermophant® T temperature switches were developed according to the standards IEC 61508 and IEC 61511-1 (FDIS). The device version with PNP switch output and additional analog output is equipped with fault detection and fault prevention facilities within the electronics and software.
- Ex-area
  The Thermophant® T is not approved for use in Ex-areas.

1. 4 Return

The following procedures must be carried out before a device is returned to Endress+Hauser:

- Always enclose a fully completed “Declaration of Contamination” form with the device. Only then can Endress+Hauser transport and examine a returned device. A copy of the “Declaration of Contamination” can be found on the second last page of these Operating Instructions.
- Remove all fluid residues. This is particularly important if the fluid is hazardous to health, e.g. flammable, toxic, caustic, carcinogenic, etc.

⚠ Warning!
Do not return a measuring device if you are not absolutely certain that all traces of hazardous substances have been removed, e.g. substances which have penetrated crevices or diffused through plastic.

2 Device identification

2. 1 Nameplate

To identify your device, compare the complete order code and the version information on the delivery papers with the data on the nameplate.

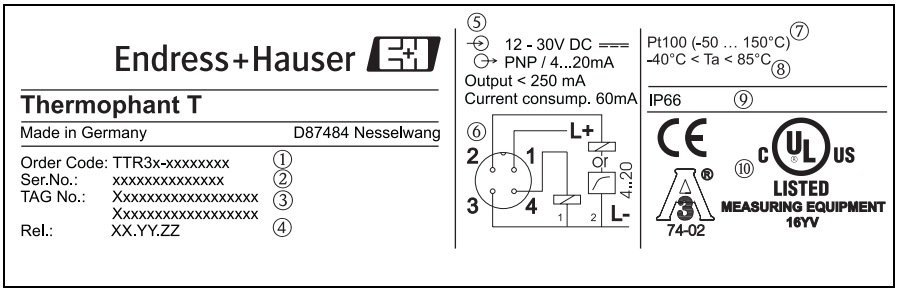


Fig. 1: Nameplate for device identification (as example)

①	Order code	⑥	Connection diagram
②	Serial number	⑦	Measuring range
③	TAG number	⑧	Ambient temperature
④	Release number (change status)	⑨	Degree of protection
⑤	Connection values	⑩	Approvals

Note!
The release number indicates the change status of the device. A change in the last two figures does not have any affect on the compatibility – see also → Chap. 8.

2. 2 Certificates and approvals

CE mark, declaration of conformity
The devices are designed and tested to meet state-of-the-art safety requirements in accordance with sound engineering practice. They have left the factory in a condition in which they are safe to operate. The devices comply with the standards EN 61010 -1 "Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures" and with the EMC requirements of IEC/EN 61326. The device described in these Operating Instructions is therefore in conformity with the statutory requirements of the EU Directives. The manufacturer confirms a positive completion of all tests by fitting the unit with a CE mark.

Hygiene standard
The TTR35 temperature switch meets the requirements of Sanitary Standard no. 74-03. Endress+Hauser confirms this by applying the 3–A symbol (not valid for process connection conical metal-metal).

UL listed for Canada and USA
The device was examined by Underwriters Laboratories Inc. (UL) in accordance with the standards UL 61010B-1 and CSA C22.2 No. 1010.1-92 and listed under the number E225237 UL.

3 Installation

3. 1 Incoming acceptance, storage

- Incoming acceptance:
  Check the packaging and the device for damage. Check that the goods delivered are complete and nothing is missing.
- Storage:
  Storage temperature -40 °C to +85 °C (-40 °F to +185 °F).

3. 2 Dimensions

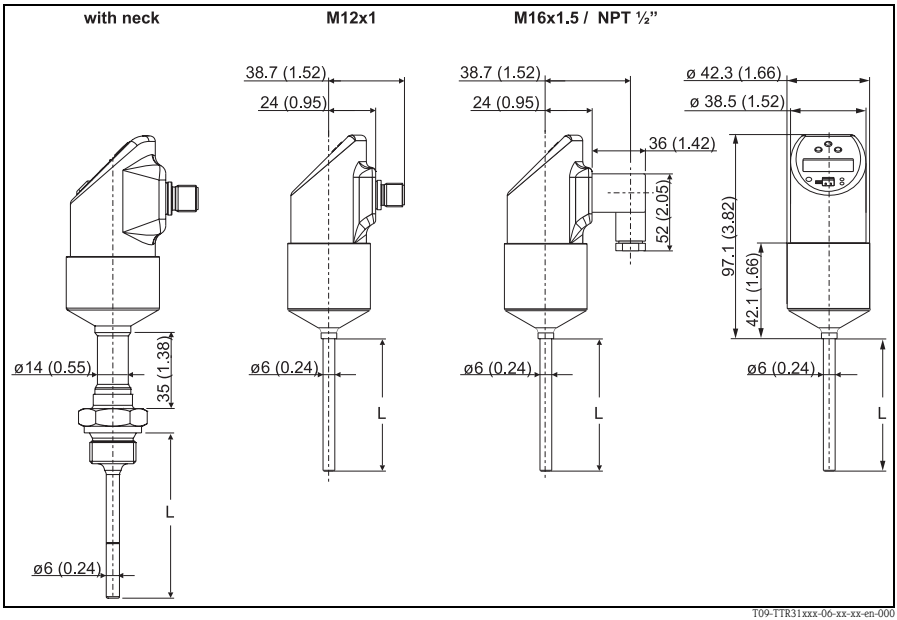


Fig. 2: Dimensions in mm (inches)

Version L in 50, 100 and 200 mm (1.97, 3.94 and 7.87"),
for TTR35 as option: L = 23 mm (0.91") and ∅ 4 mm (0.16")
M12x1 connector as per IEC 60947-5-2
M16x1.5 or NPT ½" valve plug as per DIN 43650A/ISO 4400

3. 3 Process connection

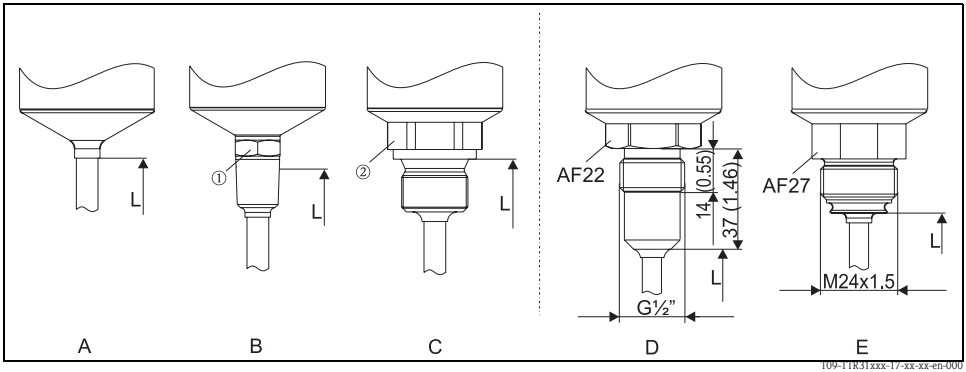


Fig. 3: Process connection of the devices

	TTR31			TTR35	
Field of application	Monitoring, display and control of process temperatures			Monitoring, display and control of process temperatures in hygienic processes	
Process connection	**Item A** Version without process connection ('w'). Suitable welding bosses and coupling (→ Chap. 7)	**Item B** Version with thread process connection ANSI NPT ¼" (① = AF14) and NPT ½" (① = AF27)	**Item C** Version with thread process connection G¼A (② = AF14) and G½A (② = AF27) as per ISO 228	**Item D** Conical metal-metal for hygienic processes, G½" thread. Suitable welding boss available as accessory (→ Chap. 7.2)	**Item E** Adapter concept - version with M24x1.5 thread for adapters with process connection for hygienic processes (→ Chap. 7.1.2)
Sensor length L	50, 100 and 200 mm (1.97, 3.94 and 7.87")				23 with Ø 4 mm (0.91" with Ø 0.16") 50, 100 and 200 mm (1.97, 3.94 and 7.87")
Measuring range	-50 °C to +150 °C (-58 °F to 302 °F) -50 °C to 200 °C (-59 °F to 392 °F), version TTR35 with neck				

Caution!
The maximum process pressure for the conical metal-metal process connection (see Fig. 3, item D) is 16 bar = 1.6 MPa (232 psi)!

3. 4 Installation instructions

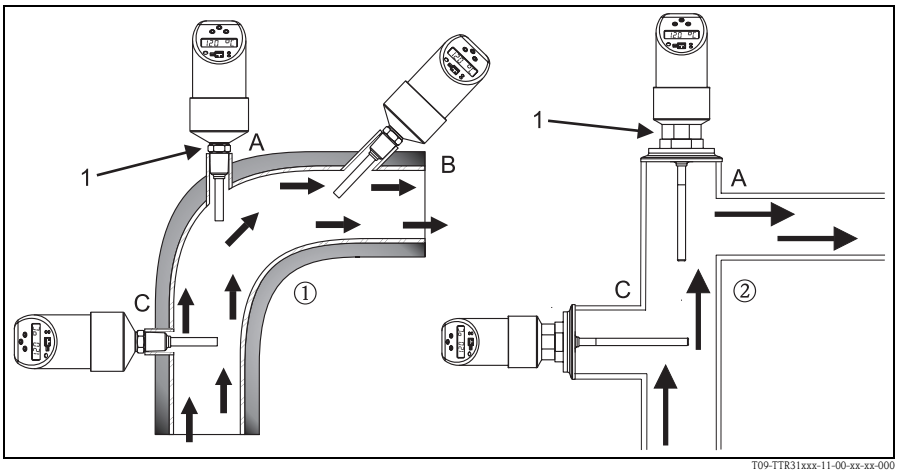


Fig. 4: Possible installation options for temperature monitoring in pipes

① *TTR31*
② *TTR35 for use in hygienic processes*

Mounting instructions:

- Installation at angle pieces, against the direction of flow (→ Fig. 4, Item A).
- Installation in smaller pipes, inclined against the direction of flow (→ Fig. 4, Item B).
- Installation vertical to the direction of flow (→ Fig. 4, Item C).
- The on-site display can be rotated electronically 180° – see section 5. 1 "On-site operation".
- The housing can be rotated up to 310°.

Caution!
Do no thread into process connection by turning housing. Always use a wrench (see table, → Chap. 3. 3) on the process connnection fluts (→ Fig. 4, Pos. 1) to tighten the sensor into the process connection.

4 Wiring

4. 1 DC voltage version with M12x1 connector

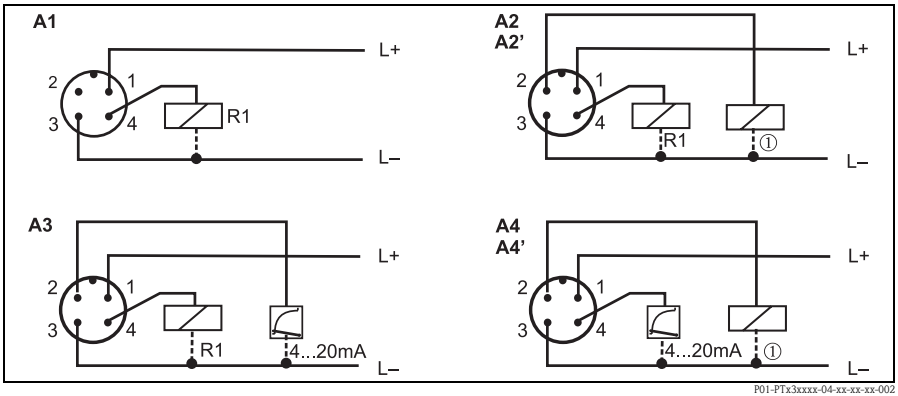


Fig. 5: Thermophant® T with M12x1 connector

A1: 1x PNP switch output

A2: 2x PNP switch outputs R1 and ①(R2)

A2': 2x PNP switch outputs R1 and ① (diagnosis/break contact with adjustment "DESINA")

A3: 1x PNP switch output and 1x analog output (4 to 20 mA)

A4: 1x analog output (4 to 20 mA) and 1x PNP switch output ①(R2)

A4': 1x analog output (4 to 20 mA) and 1x PNP switch output ①
(diagnosis/break contact with adjustment "DESINA")

Caution!
To avoid the analog input damaging of a PLC, do not connect the active PNP switch output of the device to the 4...20 mA input of a PLC.

Note!
More informations about DESINA see www.desina.de (→ Chap. 5.1.4 Basic settings).

4. 2 DC voltage version with valve connector

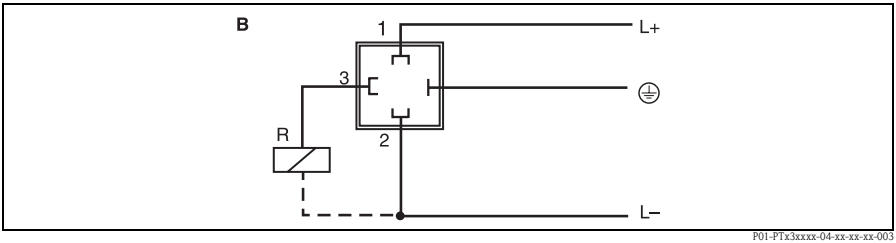


Fig. 6: Thermophant® T with M 16x1.5 or NPT ½" valve plug

B: 1x PNP switch output

5 Operation

5. 1 On-site operation

The Thermophant® T is operated by means of three keys. The digital display and the light emitting diodes (LED) support navigation in the operating menu.

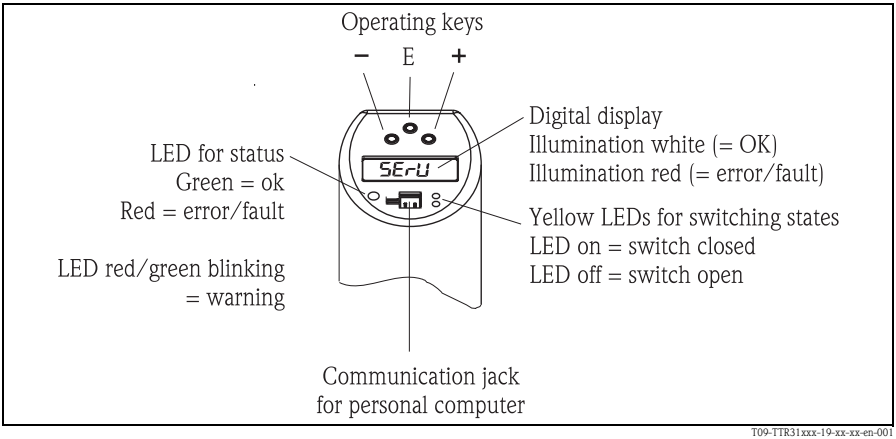


Fig. 7: Position of operating elements and possibilities for display

Digital display illumination:
- *White = OK status*
- *Red = error status*

5.1.1 Navigating in the operating menu

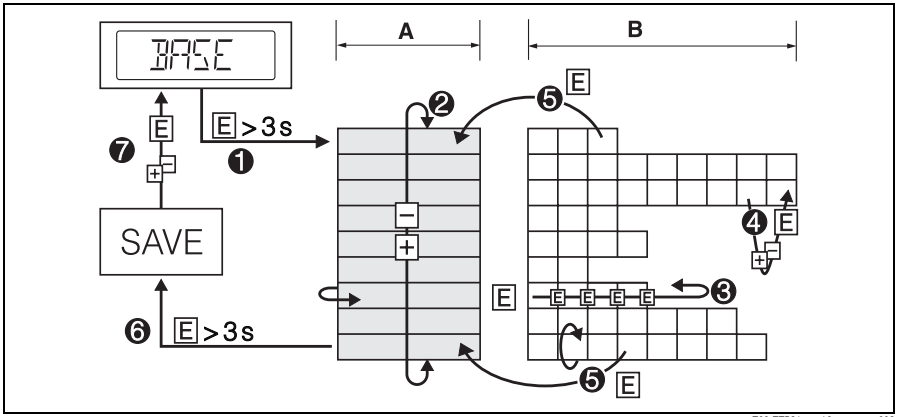


Fig. 8: Navigating in the operating menu

A Function group selection

B Function selection

① *Enter the operating menu*
– *Press the E key for longer than 3 s*

② *Select the "Function group" with the + or – key*

③ *Select the "Function" with the E key*

④ *Enter or change parameters with the + or – key*
– *Then return to "Function" with the E key*
Note: If software locking is enabled, it must be disabled before making entries or changes

⑤ *Press the E key several times to return to the "Function group"*
– *until the appropriate function group is reached again*

⑥ *Jump back to the measuring position (Home position)*
– *Press the E key for longer than 3 s*

⑦ *Query to save data (select "YES" or "NO" with the + or – key)*
– *Confirm with the E key*

Note!
Changes to the parameter settings only become effective if you choose ⑦ 'YES' when asked to save data.

5.1.2 Structure of the operating menu for 1x or 2x switch outputs

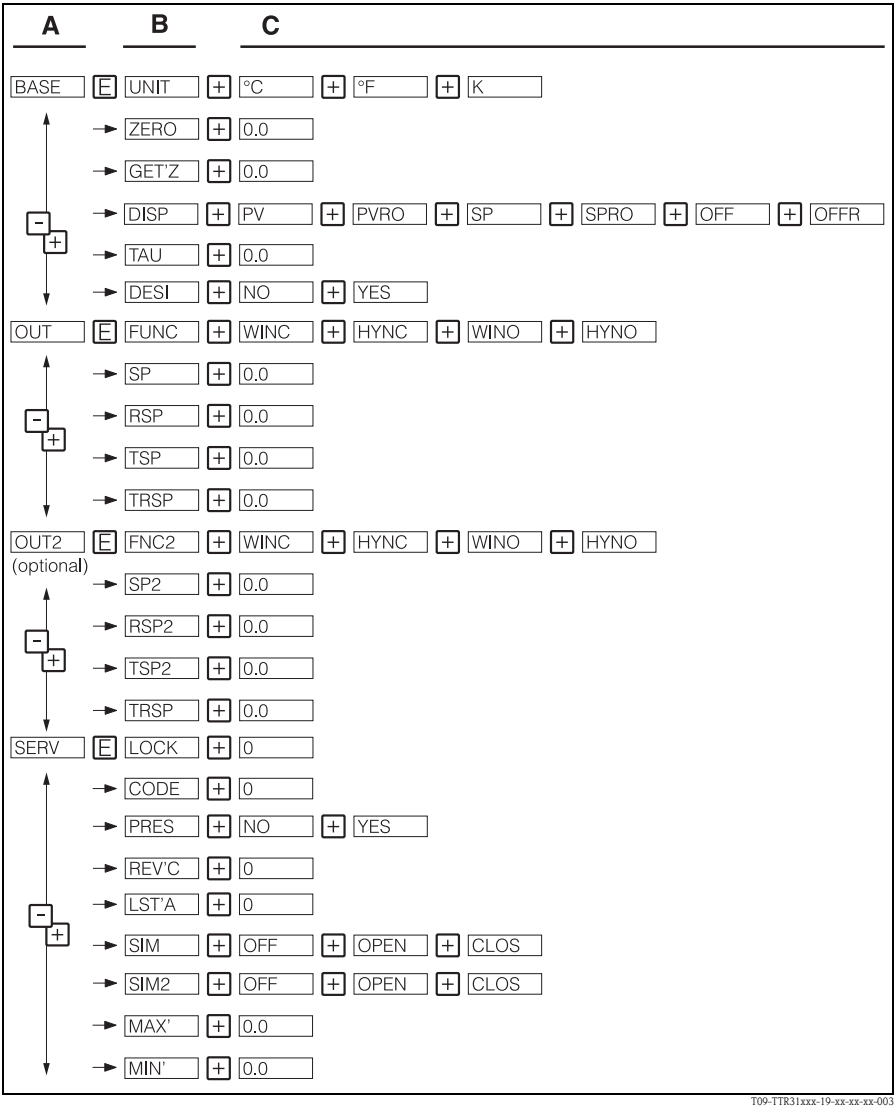


Fig. 9: Operating menu: A function groups, B functions, C settings

5.1.3 Structure of the operating menu for 1x switch output or 1x analog output (4 to 20 mA)

At devices with analog output both output 1 and output 2 can be configured as an analog output. Furthermore it is possible to configure both output 1 and output 2 as a switch output.

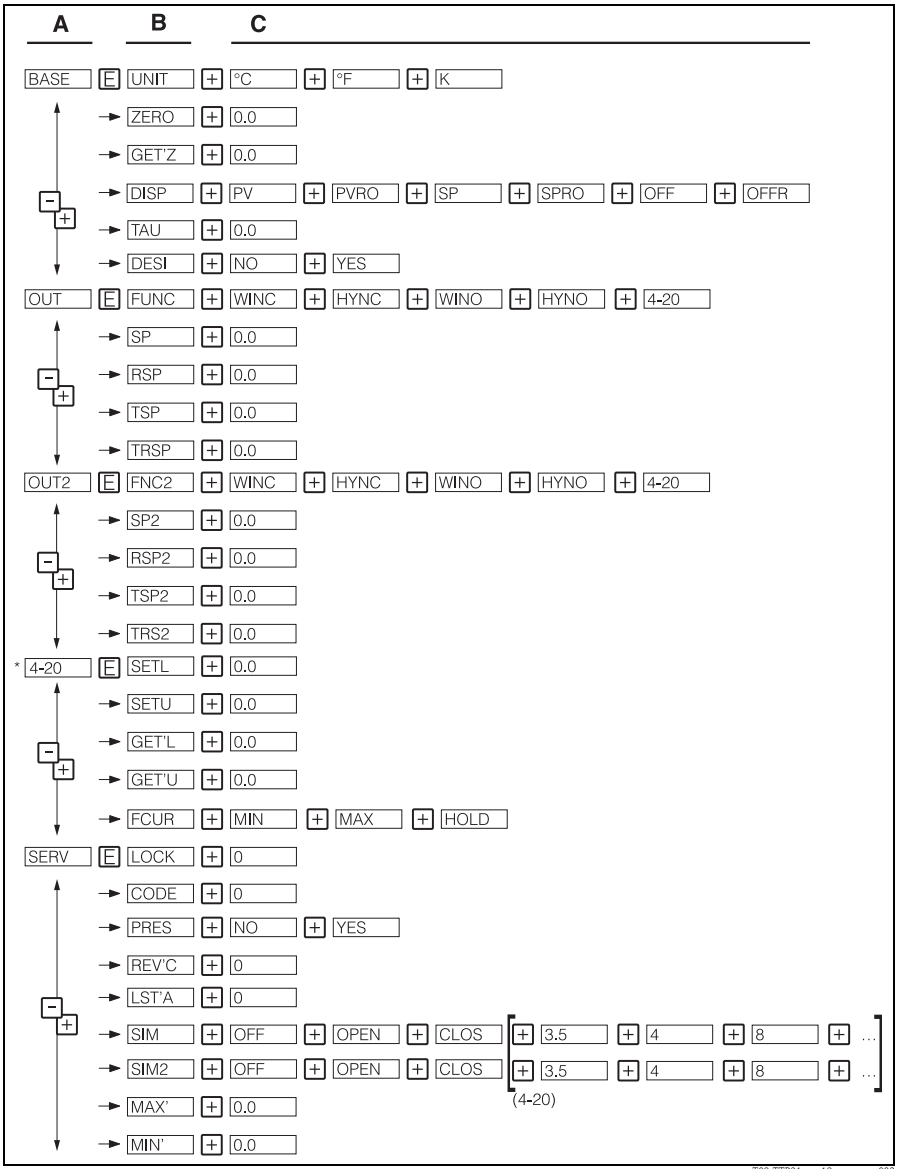


Fig. 10: Operating menu: A function groups, B functions, C settings

5.1.4 Basic settings

Note!
The function group 4-20 is only available if the 4 to 20 mA analog output (4--20) is selected in the function group OUT 1 or OUT2 under FUNC or FNC2.

Function group	Function		Settings	Description
BASE	UNIT	Technical unit	°C °F K	Select technical unit: °C, °F, K Factory setting: **°C**
	ZERO	Configure zero point	0.0	Position adjustment: within ±10 °C/K (±18 °F) of the upper range limit
	GET'Z	Accept zero point	0.0	No settings possible (not available in PC software)
	DISP	Display	PV PVRO SP SPRO OFF OFFR	PV: measured value display PVRO: measured value display rotated 180° SP: set switch point display SPRO: set switch point display rotated 180° OFF: display off OFFR: display off rotated 180° Factory setting: **measured value (PV)**
	TAU	Damping: display value, output signal	0.0	Measured value damping with regard to display value and output: 0 (no damping) or 9 to 40 s (in increments of 1 second) Factory setting: **0 s**

Function group	Function		Settings	Description
BASE	DESI	DESINA	NO YES	PIN assignment of the M12 connector is in accordance with the guidelines of DESINA Factory setting: **NO** ✎ Note! Configuration DESINA is only possible, if output 1 and output 2 are selected.

5.1.5 Settings for output - 2x switch output

- Hysteresis function
  The hysteresis function enables two-point control via a hysteresis. Depending on the temperature T, the hysteresis can be set via the switch point SP and the switch-back point RSP.
- Window function
  The window function enables the monitoring of a process temperature range.
- NO contact or NC contact
  This switch function is freely selectable.
- Factory setting (if no customer-specific settings have been ordered):
  Switch point SP 1: 45 °C (113.0 °F); Switch-back point RSP 1: 44.5 °C (112.1 °F)
  Switch point SP 2: 55 °C (131.0 °F); Switch-back point RSP 2: 54.5 °C (130.1 °F)
- Range of adjustment
  LRL = Lower Range Limit
  URL = Upper Range Limit
  LRV = Lower Range Value
  URV = Upper Range Value

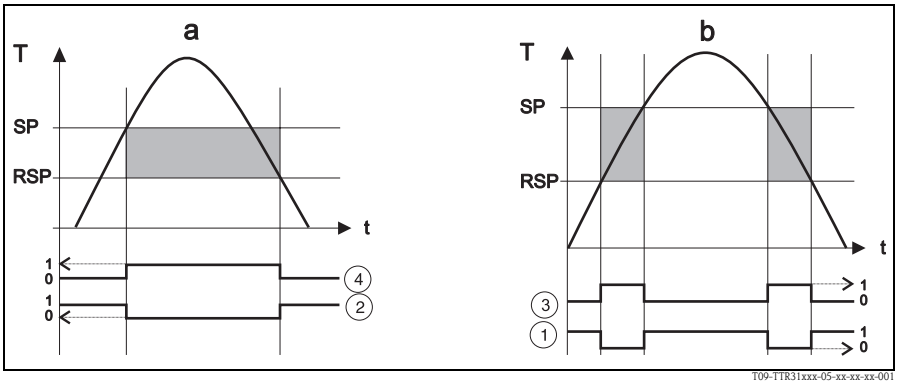


Fig. 11: Switch point functions

a: Hysteresis-function
b: Window-function
① Window - NC contact
② Hysteresis - NC contact
③ Window - NO contact
④ Hysteresis - NO contact
SP switch point; RSP switch-back point

Function group	Function		Settings	Description
OUT Output 1 OUT2 Output 2, as option	FUNC FNC2	Switching characteristic	WINC HYNC WINO HYNO	WINC: window/NC contact HYNC: hysteresis/NC contact WINO: window/NO contact HYNO: hysteresis/NO contact Factory setting: **HYNO**
	SP SP2	Switch point value	0.0	Switch point -49.5 to 150 °C (-57.1 to 302 °F) in increments of 0.1 °C (0.18 °F)

Function group	Function		Settings	Description
OUT Output 1 OUT2 Output 2, as option	RSP RSP2	Switch-back point value	0.0	Switch-back point -50 to 149 °C (-58 to 300 °F) in increments of 0.1 °C (0.18 °F)
	TSP TSP2	Switch point delay	0.0	Delay time 0...99 s in increments of 0.1 s Factory setting: **0 s**
	TRSP TRS2	Switch-back point delay	0.0	Delay time 0...99 s in increments of 0.1 s Factory setting: **0 s**
Min. distance between SP and RSP: 0.5 °C/K (0.9 °F)				

5.1.6 Settings for output - 1x switch output and 1x analog output (4 to 20 mA)

Function group	Function		Settings	Description
OUT Output 1 OUT2 Output 2, as option	FUNC FNC2	Switching characteristic	WINC HYNC WINO HYNO 4--20	WINC: window/NC contact HYNC: hysteresis/NC contact WINO: window/NO contact HYNO: hysteresis/NO contact 4 - 20: analog output Factory setting: **HYNO**
	SP SP2	Switch point value	0.0	Switch point -49.5 to 150 °C (-57.1 to 302 °F) in increments of 0.1 °C (0.18 °F)

Function group	Function		Settings	Description
OUT Output 1 OUT2 Output 2, as option	RSP RSP2	Switch-back point value	0.0	Switch-back point –50 to 149 °C (–58 to 300 °F) in increments of 0.1 °C (0.18 °F)
	TSP TSP2	Switch point delay	0.0	Delay time 0...99 s in increments of 0.1 s Factory setting: **0 s**
	TRSP TRS2	Switch-back point delay	0.0	Delay time 0...99 s in increments of 0.1 s Factory setting: **0 s**
Min. distance between SP and RSP: 0.5 °C/K (0.9 °F)				
4--20 Analog output	SETL	Value for 4 mA (LRV)	0.0	–50 to 130 °C (–58 to 266 °F) Lower range value in increments of 0.1 °C (0.18 °F) Factory setting: **0.0 °C (32.0 °F)**
	SETU	Value for 20 mA (URV)	0.0	–30 to 150 °C (–22 to 302 °F) Enter upper range value in increments of 0.1 °C (0.18 °F) Factory setting: **150 °C (302 °F)**
	GET'L	Temperature applied for 4 mA (LRV)	0.0	Take temperature value as lower range value (not via PC software)
	GET'U	Temperature applied for 20 mA (URV)	0.0	Take temperature value as upper range value (not vial PC software)

Function group	Function		Settings	Description
4--20 Analog output	FCUR	Error current	MIN MAX HOLD	Current value in event of error: MIN = ≤ 3.6 mA MAX = ≥ 21.0 mA HOLD = last value Factory setting: **MAX**
Min. distance between SETL and SETU: 20 °C/K (36 °F)				

✎ Note!
The function group 4-20 is only available if the 4 to 20 mA analog output (4--20) is selected in the function group OUT 1 or OUT2 under FUNC or FNC2.

5.1.7 Settings for service functions

Function group	Function		Settings	Description
SERV Service functions	LOCK	Locking code	0	Enter the locking code for enabling the device.
	CODE	Change locking code	0	Freely selectable code 1...9999. 0 = no locking; A locking code already assigned can only be changed by first entering the old code for enabling the device.
	PRES	Reset	NO YES	Reset all entries to the factory setting
	REV'C	Revision counter	0	Increases by 1 with each configuration
	LST'A	Last device status	0	Displays the last device status to occur ≠ 0

Function group	Function		Settings	Description
SERV Service functions	SIM SIM2 (if output 2 available)	Simulation output 1 or 2	OFF OPEN CLOS 3.5 (if analog output available)	OFF: No simulation OPEN: Switch output open CLOS: Switch output closed 3.5: Simulation values for analog output in mA (3.5/4.0/8.0/12.0/ 16.0/20.0/21.7)
	MAX'	Max. indicator	0.0	Display of max. measured process value
	MIN'	Min. indicator	0.0	Display of min. measured process value

5. 2 Operation with PC

The device can be configured with the configuration software ReadWin® 2000 or FieldCare. For the connection between the USB port of the computer and the device a configuration kit (e.g. TXU10) is necessary.

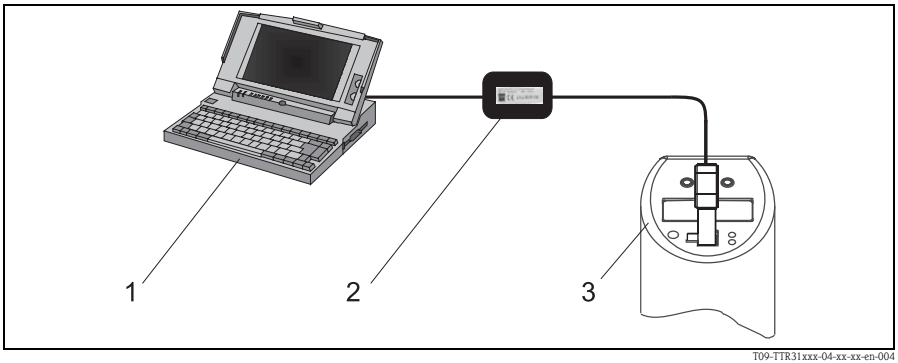


Fig. 12: Operation with PC

Item 1: PC with configuration software ReadWin® 2000 or FieldCare
Item 2: Configuration kit TXU10-AA or FXA291
Item 3: Temperature switch

5.2.1 Additional operating options

In addition to the operating options listed in the previous "On-site operation" section, the ReadWin® 2000 or FieldCare configuration software provides further information on the Thermophant® T:

Function group	Description
SERV	Number of switch changes for output 1
	Number of switch changes for output 2
	Device status
INFO	Tag number
	Order code
	Limit switch serial number
	Sensor serial number
	Electronics serial number

Function group	Description
INFO	Device release (change status)
	Hardware version
	Software version

5.2.2 Hints for the configuration with Readwin® 2000

Comprehensive information on the ReadWin ® 2000 configuration software may be found in the Operating Instructions BA137R/09/en.

5.2.3 Hints for the configuration with FieldCare

FieldCare is an universal configuration software based on FDT/DTM technology.

Note!

- To configure the Thermophant® T TTR31/35 with FieldCare the "PCP (ReadWin) Communication DTM" and the Thermophant Device-DTM are required.
- All devices with software version 1.01.00 or higher can be configured with FieldCare.
- The device supports only offline configuration and up-/download of parameters. The online configuration is not supported.

Detailed information concerning FieldCare may be found in the operation manual (BA027S/c4) or see: www.endress.com.

6 Maintenance

Any buildup on the sensor can have a negative effect on the sensor response time. For this reason, check the sensor for buildup at regular intervals.

Caution!

Make sure the process is unpressurized before you remove the device! Do not twist the device out of the process connection thread at the housing. Always use a suitable open-ended wrench for disassembly work (→ Chap. 3. 3 and → Fig. 4).

7 Accessories

If ordering accessories, please specify the serial number of the unit! All dimensions in the drawings are given in mm (inches).

7. 1 Adapter concept for TTR35

The process connection is an adapter and the sensor module has an adapter thread (see section 3. 3, process connection). As a result, the process connection can easily be changed at a later stage.

7.1.1 Adapter change

The adapter can be changed on TTR35.

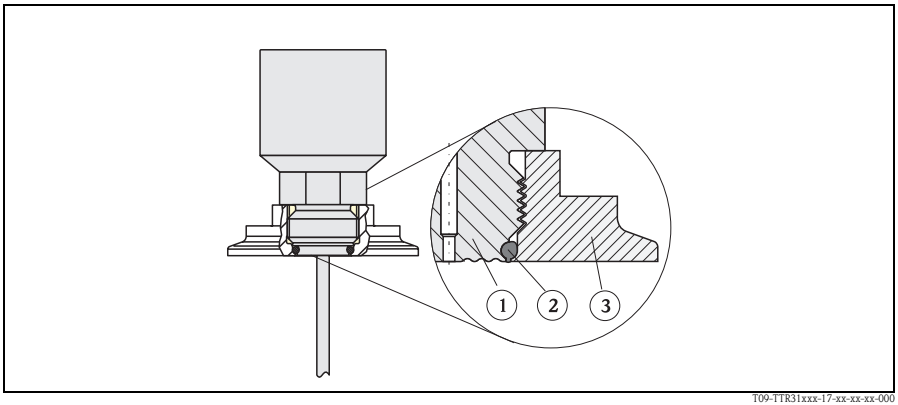


Fig. 13: Changing the adapter

① *Sensor module with adapter thread*
② *Standard O-ring*
③ *Adapter*

Please note the following when changing the adapter:

- Use a new O-ring. Diameter 15.54 x 2.62 mm (0.612" x 0.103").
  EPDM 70 Shore FDA 3-A approved.
- Fix the device (sensor module) in place with an open-ended wrench AF 27. Never hold the housing of the device to loosen or tighten the process connection adapter.
- The adapter can be screwed on with an open-ended wrench AF 27 or AF 32, depending on the process connection, (see section 7.1.2 adapter versions).
  The maximum torque is 80 Nm. The thread can become loose if exposed to severe strain through pressure and temperature. For this reason, the air-tightness must be checked regularly and the thread tightened if necessary.
- When changing the adapter, make sure that the sensor tube of the sensor is not damaged.

Note!
We recommend to change the O-ring in the same time frame as of all other sealings in your process.

7.1.2 Adapter versions

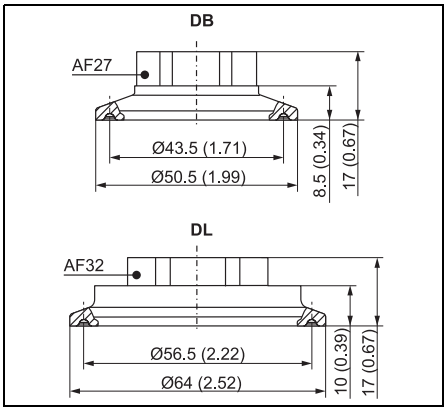
EN10204-3.1 = Material certificate (melt analysis)

DTT35: order numbers for clamp adapter versions.

- Version DB (Clamp ISO2582 DN25 - 38): order no. 52023994
- Version DL (Clamp ISO2582 DN40 - 51): order no. 52023995

Optional with EN10204-3.1:

- Version DB (Clamp ISO2582 DN25 - 38): order no. 52024001
- Version DL (Clamp ISO2582 DN40 - 51): order no. 52024002



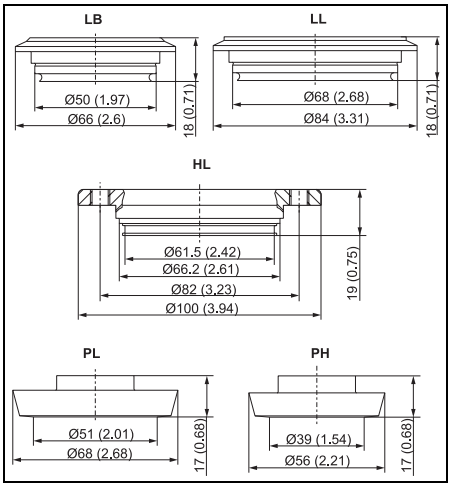
P01-PTx3xxxx-06-xx-xx-en-009

TTR35: order numbers hygiene adapter versions.

- Version LB (Varivent F pipe DN25 – 32, PN40): Order no. 52023996
- Version LL (Varivent N pipe DN40 – 162, PN40): Order no. 52023997
- Version HL (APV-Inline DN50 PN40): Order no. 52024000
- Version PH (DIN11851 DN40 PN40): Order no. 52023999
- Version PL (DIN11851 DN40 PN40): Order no. 52023998

Optional with EN10204-3.1:

- Version LB (Varivent F pipe DN25 – 32, PN40): Order no. 52024003
- Version LL (Varivent N pipe DN40 – 162, PN40): Order no. 52024004
- Version HL (APV-Inline DN50 PN40): Order no. 52024007
- Version PH (DIN11851 DN40 PN40): Order no. 52024006
- Version PL (DIN11851 DN40 PN40): Order no. 52024005



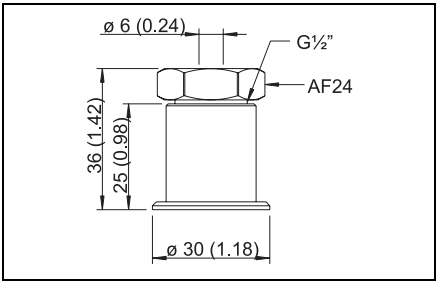
7.1.3 O-ring for adapter replacement

O-ring 15.54 x 2.62 mm (0.61 x 0.1 in), EPDM 70 Shore FDA, order no. 51008363

7.2 Welding bosses and coupling

7.2.1 Welding boss with sealing taper

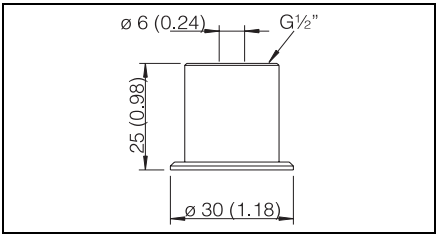
Collar welding boss moveable with sealing taper and pressure screw; material of parts in contact with the process: 316L, PEEK,
max. process pressure 10 bar (145 psi)
Order number: 51004751



T09-TSM470AX-06-09-00-en-000

7.2.2 Collar welding boss

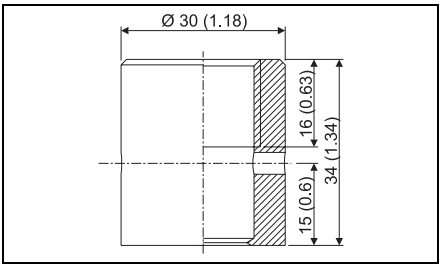
Material of parts in contact with process: 316L
Order no. 51004752



T09-TSM470BX-06-09-00-en-000

7.2.3 Welding boss with sealing taper (metal-metal)

Welding boss
Seal, metal-metal,
Material of parts in contact with process: 316L
Max. process pressure 16 bar (232 psi)
Order no. 60021387



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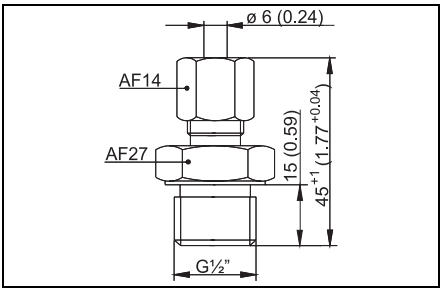
7.2.4 Coupling with sealing taper

Moveable coupling, G½" process connection, coupling and parts in contact with process: 316L
Order no. 51004753

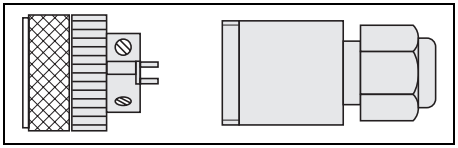


T09-TSM470AX-06-09-00-en-001

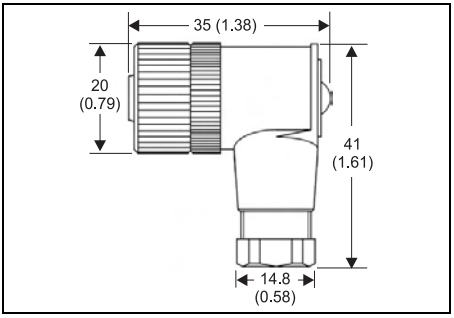
7.3 Electrical connection

7.3.1 Plug-in jack; connecting cable

Coupling M12x1; straight
Connection to M12x1 housing connector
Order number: 52006263

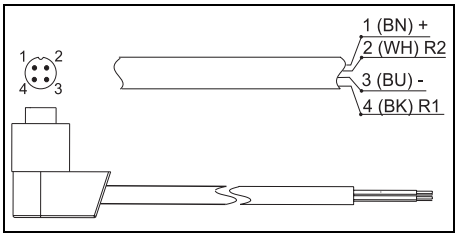

P01-PMP13xxx-00-xx-00-xx-003

Coupling M12x1; elbowed
Connection to M12x1 housing connector
IP 67, PG7
Order number: 51006327



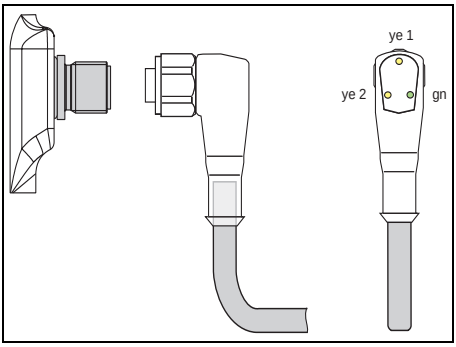
T09-TTR3xxxx-06-09-xx-en-000

PVC cable, 4 x 0.34 mm² (22 AWG) with M12x1 coupling, elbowed, screw plug, length 5 m (16.4 ft), IP 67
Order number: 51005148
Core colours:
- 1 = BN brown
- 2 = WH white
- 3 = BU blue
- 4 = BK black



T09-TTR31xXX-00-00-xx-xx-002

PVC cable, 4 x 0.34 mm^2 (22 AWG) with M12x1 coupling, with LED, elbowed, 316L screw plug, length 5 m (16.4 ft), specially for hygiene applications, IP 69K
Order number: 52018763
Display:
–gn: device operational
–ye1: switch status 1
–ye2: switch status 2

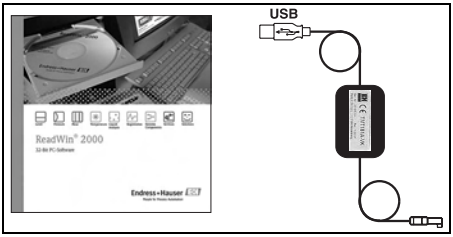


T09-TTR31xxx-00-00-xx-xx-001

✎
Note!
Not for use at devices with "4 to 20 mA analog output" option!

7.4 Configuration kit

- Configuration kit for PC-programmable transmitters – ReadWin® 2000 setup program and interface cable for PCs with USB port; Adapter for transmitters with 4-pole post connector
  Order code: TXU10-AA
- ReadWin® 2000 can be downloaded free of charge directly from the internet at the following address:
  www.endress.com/readwin



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8 Trouble-shooting

8. 1 Errors and warnings

If an error in the device occurs, the colour of the status LED changes from green to red and the digital display illumination changes from white to red. A status LED flashing red and green signals a warning. The display shows:

- E-code for errors
  In the event of an error message, the measured value is uncertain.
- W-code for warnings
  In the event of a warning, the measured value is reliable.

Code	Explanation	Remedy
E011	Device configuration faulty	Reset device (→ Chap. 5.1.7)
E012	Error in measurement or medium temperature outside specification	Check medium temperature, return device to E+H where necessary
E019	Power supply outside specification	Check operating voltage
E015	Memory error	Return device to E+H
E020		
E021		
E022	Power is only supplied to the device via the communication interface (measurement is deactivated)	Check operating voltage
E025	Switching contact 1 is not open although it should be	Switching contact defective, return device to E+H
E026	Switching contact 2 is not open although it should be	Switching contact defective, return device to E+H
E040	VCC (Controller voltage) is out of working area	Return device to E+H
E042	Output current can no longer be generated (only for 4 to 20 mA output, e.g. load at analog output too high or open analog output)	Check load. Switch off analog output via configuration, if it isn't required, → Chap. 5.1.6.

Code	Explanation	Remedy
E044	Output current drifts too much (± 0.5 mA)	Return device to E+H

Code	Explanation	Remedy
W107	Simulation active	Switch off the output simulation for output 1 and output 2
W202	Measured value outside of the sensor range	Operate the device in the specified temperature range
W209	Device starts	
W210	Configuration modified (warning code will be displayed for 15 s approx.)	
W212	Sensor signal outside the permitted range	Operate the device in the specified temperature range
W250	Number of switch cycles exceeded	Replace the device
W270	Short-circuit or overload at output 1	Check output wiring. Extend the load resistance at output 1
W280	Short-circuit or overload at output 2	Check output wiring. Extend the load resistance at output 2

8. 2 Repair

A repair is not planned.

8. 3 Disposal

Please pay particular attention to the local disposal regulations of your country. When disposing, ensure that the materials of the device components are separated and processed accordingly.

8. 4 Software history and compatibility overview

The release number on the nameplate and in the Operating Instructions indicates the change status of the device: XX.YY.ZZ (example 01.02.01).

XX	Change in the main version. Compatibility no longer provided. Device and Operating Instructions change.
YY	Change in functionality and operation. Compatibility provided. Operating Instructions change.
ZZ	Trouble-shooting and internal modifications. Operating Instructions do not change.

Software history

Date	Release no. device	Changes in software	Documentation
06.2004	01.00.00		KA174r/09/en (51008032)
12.2004	01.01.00	New analog electronics	BA201r/09/en/02.05 (51009833)
02.2005	01.02.00	Internal	BA201r/09/en/02.05 (51009833)
02.2006	01.02.01	Parameter functional safety for the optional analog output is not applicable	BA229r/09/en/03.06 (71025405)

9 The most important technical data

9. 1 Power supply

Supply voltage
- DC voltage version 12...30 V DC

Current consumption
- Without load < 60 mA, with reverse polarity protection

Power supply failure
- Behaviour in case of overvoltage (> 30 V)
  The device works continuously up to 34 V DC without any damage. No damage is caused to the device in case of a short-term overvoltage up to 1 kV (as per IEC 61000-4-5). If the supply voltage is exceeded, the properties specified are no longer guaranteed.
- Behaviour in case of undervoltage
  If the supply voltage drops below the minimum value, the device switches off (status as if not supplied with power = switch open).

9. 2 Output

Switching capacity
- Switch status ON: $I_a \leq 250$ mA
- Switch status OFF: $I_a \leq 1$ mA
- Switching cycles: > 10,000,000
- Voltage drop PNP: ≤ 2 V
- Overload protection
  Automatic load testing of switching current; output is switched off in case of overcurrent, the switching current is tested again every 0.5 s; max. capacitance load: 14 µF for max. supply voltage (without resistive load).

Load (analog output)
- Max. (V_{supply} – 6.5 V) / 0.022 A

Signal on alarm
- Analog output: ≤ 3.6 mA or ≥ 21.0 mA adjustable
  (if setting ≥ 21.0 mA the output is ≥ 21.5 mA)
- Switch outputs: in safe state (switch normally open)

9. 3 Operating conditions

- Any orientation
- Any position-dependent zero shift can be corrected
  Offset: ±20 % URL

9.3.1 Environment

- Ambient temperature range
  –40...+85 °C (-40...+ 185 °F)
- Storage temperature
  –40...+85 °C (-40...+ 185 °F)

9.3.2 Process

Process temperature limits
- -50 to 150 °C (-58 to 302 °F) generally,
- -50 to 200 °C (-58 to 392 °F) version TTR35 with neck

Caution!
Restrictions depending on process connection and ambient temperature:
- No restriction with coupling (see Accessories, → Chap. 7.2.1, → Chap. 7.2.4, order no. **51004751**, **51004753**) and neck tube length min. 20 mm (0.79").
- with process connection:

max. ambient temperature	max. process temperature
up to 25 °C (77 °F)	no restriction
up to 40 °C (104 °F)	135 °C (275 °F)

up to 60 °C (140 °F)	120 °C (248 °F)
up to 85 °C (185 °F)	100 °C (212 °F)

Process pressure limits
Maximum permitted process pressure depending on the insertion length.

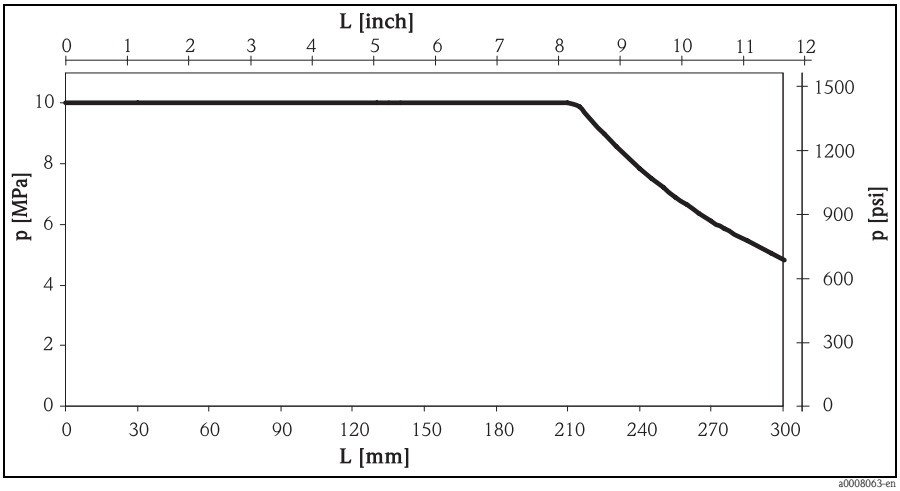

Fig. 14: Maximum permitted process pressure

L = insertion length
p = process pressure

The diagram takes into consideration not only the overpressure but also the pressure load caused by the flow, whereby a safety factor of 1.9 has been specified for operation with flow. The maximum permitted static operating pressure is lower at greater insertion lengths due to the increased bending load caused by the flow. The calculation assumes the maximum permitted medium velocity for the respective insertion length (see diagram below).

Caution!
The maximum process pressure for the conical metal-metal process connection (see Fig. 3, item D) is 16 bar = 1.6 MPa (232 psi)!

Permitted flow velocity depending on the insertion length.

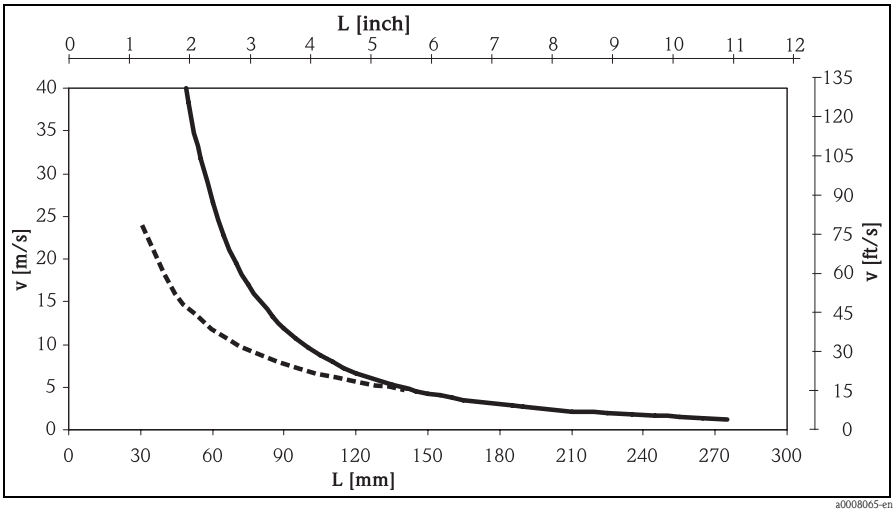

Fig. 15: Permitted flow velocity

L = insertion length, during flow
v = flow velocity
Medium: —— air; - - - - - water

The permitted flow velocity is the minimum from resonance velocity (resonance distance 80%) and load or buckling caused by flow, which would lead to failure of the thermometer tube or to exceedance of the safety factor (1.9). Calculation was performed for the specified limit operating conditions of 200°C (392°F) and ≤10 MPa (1450 PSI) process pressure.

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